The Linear Momentum Equation using a Non-Inertial Frame of Reference

The SpaceX Falcon 9 rocket and Crew Dragon spacecraft carrying NASA astronauts Douglas Hurley and Robert Behnken lifts off during NASA's SpaceX mission to the International Space Station from the Kennedy Space Center in Cape Canaveral, Fla., on May 30, 2020.

THOM BAUR/REUTER

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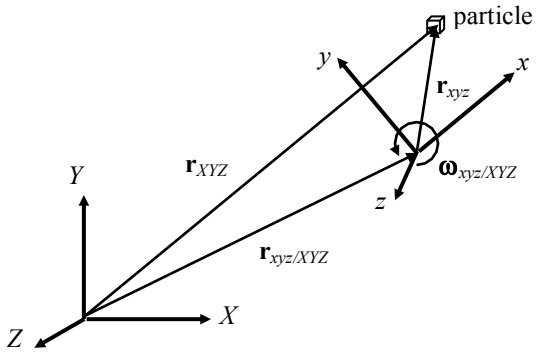

$$\mathbf{F}_{\text{body on CV}} + \mathbf{F}_{\text{surface on CV}}$$
$$- \int_{\text{CV}} \left\{ \mathbf{a}_{xyz/XYZ} + \left(\dot{\boldsymbol{\omega}}_{xyz/XYZ} \times \mathbf{r}_{xyz} \right) + \left(2\boldsymbol{\omega}_{xyz/XYZ} \times \mathbf{u}_{xyz} \right) + \left[\boldsymbol{\omega}_{xyz/XYZ} \times \left(\boldsymbol{\omega}_{xyz/XYZ} \times \mathbf{r}_{xyz} \right) \right] \right\} \rho \, dV$$
$$= \frac{d}{dt} \int_{\text{CV}} \mathbf{u}_{xyz} \rho \, dV + \int_{\text{CS}} \mathbf{u}_{xyz} \left(\rho \mathbf{u}_{\text{rel}} \cdot d\mathbf{A} \right)$$